ASSEMBLY

BACKGROUND OF THE INVENTION

[1] The present invention relates to assemblies, in particular assemblies having two components secured together by a deforming process, such as heat staking, mechanical deforming or methods using ultrasonics, and a further component.

[2] In particular the invention is applicable to providing an assembly of a door panel, a window regulator housing and a window regulator motor of a land vehicle such as a car (automobile).

[3] Many methods of securing components are known, amongst which is the technique of passing a thermoplastic protuberance from one component, through a hole in a second component and subsequently heating and upsetting the protuberance to form a rivet-like head and allowing the rivet like head to cool. This technique, is known, and is called heat staking. After cooling, a secure connection between the two components is established, the two components now forming a heat staked subassembly. However, the formation of the rivet-like head potentially obstructs the subsequent alignment and fitting of a further component to the heat staked subassembly.

SUMMARY OF THE INVENTION

[4] An object of the present invention is to provide an improved assembly which enables a further component to be releaseably secured to and/or aligned with a subassembly.

[5] Another object of the present invention is to provide an assembly wherein the components of the assembly can be aligned relative to each other.

[6] Another object of the present invention is to provide an assembly wherein a deformed portion does not interfere with alignment or fitting of a further component.

[7] Thus, according to the present invention there is provided an assembly including a first, second, and third component, the first component being secured to the second component by a deformed portion to provide a subassembly, in which the deformed

portion is utilised to releaseably secure the third component to the sub assembly via a fourth component.

BRIEF DESCRIPTION OF THE DRAWINGS

[8] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

[9] Figure 1 is a schematic view of a door panel and a window regulator housing according to the present invention prior to assembly,

[10] Figure 2 shows the components of Figure 1 after alignment,

[11] Figure 3 shows the components of Figure 2 after the application of heat an upsetting tool,

[12] Figure 4 shows the components of Figure 3 and a window regulator motor,

[13] Figure 4A shows the components of Figure 4 after being releaseably secured by a fourth component,

[14] Figure 5 shows a further embodiment of the present invention,

[15] Figure 6 shows a further embodiment of the present invention, and

[16] Figure 7 shows a further embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[17] With reference to Figure 1, there is shown a door panel 12 (also known herein as a first component) and part of a window regulator housing 14 (also known herein as a second component). The window regulator housing 14 might typically contain a drum around which has been wound a cable, rotation of the drum causing movement of the cable and hence raising or lowering of the window glass via separate components of the window regulator. Note that the present invention is not restricted to window regulators containing drums with cables.

Sub A1

[18] The door panel 12 can be in the form of a door inner skin, i.e. a pressed component having various holes and attachments features for components such as door

hinges, door latch, audio speakers, window regulator components etc. Alternatively the door panel 12 can be in the form of a door module i.e. a panel onto which is pre-mounted various components such as window regulator components, and audio speaker, a door latch etc. with this pre assembled door module being mounted in a relatively large aperture of a door inner skin. Alternatively the door panel 12 can be a panel plate, such as a window regulator mounting plate, onto which parts of a window regulator are mounted.

Sub A2

[19] Consideration of Figure 1 shows that the door panel 12 includes a feature in the form of a protrusive part 18, the protrusive part comprising a cylindrical portion 20, and frustoconical portion 22. The protrusive part 18 has an inside surface 23 and an outside surface 21. The door panel 12 has an outer surface 24 and an inner surface 39.

[20] The window regulator housing 14 includes a recess 32, the boundaries of the recess 32 defined by internal side wall 30 and a projecting cylinder 26, the internal side walls 32 having substantially the same form as the outside surface 21 of the protrusive part 18 of the door panel 12. The window regulator housing 14 has an inner surface 34.

[21] Further consideration of Figure 1 shows that the height of the projecting cylinder 26 is such so as to prevent the projecting cylinder 26 from engaging in the hole in the protrusive part 18 before the cylindrical portion 20 has engaged in the side wall 30 of the recess 32, i.e. the dimension D_2 is greater than the dimension D_1. This ensures that during assembly of the window regulator housing 14 and the door panel 12, the projecting cylinder 26 is not damaged by engagement with the frustoconical portion 22 of the protrusive part. It can be seen that the cylindrical portion 20 of the feature (protrusive part 18) engages side wall 30 (and hence aligns the first and second components) whilst the (pre deformed) cylinder 26 is remote from the frustoconical portion 22.

Sub A3

[22] It can be seen from Figure 2 that the engagement between the recess 32 and the protrusive part 18 and the engagement between the inner surface 34 and the outer surface 24 provides alignment of the window regulator housing 14 and the door panel 12 in both the X, i.e. fore and aft, and Y, i.e. lateral direction relative to the vehicle.

[23] Consideration of Figure 3 shows that it is possible to provide a deformed portion by applying both heat, and a suitable upset tool to the cylinder 26, which results in a heat staked portion 28 being formed in the recess 32. The heat staked portion 28 forms against the frustoconical portion 22 of the door panel 12, providing a secure and sealed connection between the window regulator housing 14 and the door panel 12. The connection of the door panel 12 and the window regulator housing 14 results in the formation of a subassembly 15.

[24] The upset tool is configured such that the heat staked portion has a surface 29 which is substantially flat. The distance between the inner surface 39 of the door panel 12 and the flat surface 29 of the heat staked portion 28 is H_A.

[25] The window regulator housing 14 has a second component hole, in the form of a through hole 36 concentric with the protrusive part 18 to allow for the passage of a fourth component (see Figure 4A) as will be described further below.

[26] Figures 4 and 4A show an exploded view of an assembly 10, which includes the subassembly 15 and a drive mechanism in the form of a window regulator motor 16 (also known herein as a third component). In further embodiments, the drive mechanism could be in the form of a manual window winder. The window regulator motor 16 has a cylindrical protuberant part 42, with an end surface 44 and a side surface 45. The window regulator motor 16 has an outer surface 38.

[27] In this embodiment, the distance between the outer surface 38 and the end surface 44 of the protuberant part 42, is H_1 which in this case is equal to H_A, hence the end surface 44 is in contact with the flat surface 29 of the heat staked portion 28 and the outer surface 38 of the window regulator motor 16 is in contact with the inner surface 39 of the door panel 12.

[28] Alignment in the Y direction is determined by contact between surfaces 44 and 29 and between surfaces 38 and 39, and is thus sensitive to any tolerances on the dimensions H_1 and H_A.

[29] Consideration of Figure 4 shows that alignment in the X direction between the window regulator motor 16 and the window regulator housing 14 is provided by co-operation between the internal side walls 30 and the outside surface 21 of the protrusive part 18 and also by co-operation between the inside surface 23 of the protrusive part 18 and the side surface 45 of the protuberant part 42.

[30] A third component hole, in the form of a through hole 40 is located within the protuberant part of the window regulator motor 16, the hole 40 being aligned with the hole 36 of the window regulator housing 14.

SUB A4

[31] With reference to Figure 4A, the through hole 40 allows for the passage of the fourth component (which in this embodiment is in the form of a nut and bolt 19), of assembly 10, through hole 40 and hole 36. After passing the bolt through hole 40 and hole 46, the window regulator motor is then secured to the subassembly using the nut 19A. Thus the window regulator motor 16 can be removed and replaced using the nut, allowing possible replacement or repair.

SUB A5

[32] It can be seen that it is the heat staked portion that is utilised, by providing the hole through which the bolt passes, to secure the window regulator motor 116 to the subassembly 115. It should be noted that in this embodiment, hole 40 and hole 46 are not threaded holes and are of equal diameter.

[33] With reference to Figure 5, there is shown an assembly 110 in which components that perform the same function as those in assembly 10 are labelled 100 greater. However in this case the protuberant part 142 has an end surface 144 and a side surface 145, with the distance between the end surface 144 and the outer surface 138 being H_2, which is less than H_A.

[34] Alignment in the Y direction is determined by contact between the outer surface 138 and the inner surface 139, and there is no contact between the heat staked portion surface 129 and the end surface 144. Hence the alignment in the Y direction between the window regulator housing 114 and the window regulator motor 116 is only sensitive to tolerances on the thickness of the door panel 112.

[35] Consideration of Figure 5 shows that, as in the previous embodiment, alignment in the X direction between the window regulator motor 116 and the window regulator housing 114 is provided by co-operation between the internal side wall 130 and the outside surface 121 of the protrusive part 118 and also by co-operation between the inside surface 123 of the protrusive part 118 and the side surface 145 of the protuberant part 142.

Sub A6

[36] Furthermore in this embodiment the window regulator housing 114 does not include a hole equivalent to hole 36. The window regulator motor 116 is secured to the subassembly 115 by the fourth component, which in this embodiment is a self tapping screw 119. Thus the window regulator motor 16 can be removed and replaced using the self tapping screw, allowing possible replacement or repair. It can be seen that it is the heat staked portion that is utilised, by receiving the self tapping screw 119, to secure the window regulator motor 116 to the subassembly 115. Note in this embodiment, the only contact between the window regulator motor and the window regulator housing is via the self tapping screw.

[37] In an alternative embodiment, the upset tool may be configured so as to provide a countersunk feature in the heat staked portion surface 129. This countersunk feature would then act to provide a lead-in for the self tapping screw.

Sub A7

[38] Note than in other embodiments, the subassembly may include a hole, with the window regulator motor not including a hole, so that the self tapping screw passes through the heat staked portion of the subassembly and is received by the window regulator motor. The window regulator motor can therefore again be removed and replaced using the self tapping screw.

Sub A9

[39] The accessibility to a particular side of the assembly 10 determines which of the subassembly and the window regulator motor includes the hole since access to the head of the self tapping screw is required. However in later embodiments (Figure 7) in which self tapping screws are described, both the subassembly and the window regulator motor may include holes.

Sub A9

[40] With reference to Figure 6, there is shown an assembly 210 including the subassembly 115 of Figure 5 and window regulator motor 216 having an outer surface 238 and a protuberant part 242 which has an end surface 244 and a side surface 245. The distance between the end surface 244 and the outer surface 238 is H_3, which is greater than H_4.

Sub A10

[41] Alignment in the Y direction is determined by contact between the heat staked portion surface 129 and the end surface 244, and there is no contact between the outer surface 238 and the inner surface 139. Hence the alignment in the Y direction between the window regulator housing 114 and the window regulator motor 216 is not sensitive to tolerances on the thickness of the door panel 112.

Sub A11

[42] Thus it can be seen that the window regulator motor co-operates with the heat staked portion to provide alignment in the Y direction between the window regulator motor and the window regulator housing.

[43] Consideration of Figure 6 shows that, as in the previous embodiment, alignment in the X direction between the window regulator motor 216 and the window regulator housing 114 is provided by co-operation between the internal side wall 130 and the outside surface 121 of the protrusive part 118 and also by co-operation between the inside surface 123 of the protrusive part 118 and the side surface 245 of the protuberant part 242.

Sub A12

[44] In this embodiment the subassembly 215 includes a hole 236, and the window regulator motor 216 includes a hole 240. The subassembly and the window regulator motor are secured using a fourth component in the form of a bolt (not shown in this embodiment), the bolt passing through hole 240 and screwing into the threaded hole 236, so as to releaseably secure the window regulator to the subassembly.

[45] Note that in other embodiments, hole 240 may be a threaded hole, with the bolt passing through hole 236 and screwing into the threaded hole 240, so as to releaseably secure the window regulator to the subassembly.

[46] As in the embodiment described in Figure 5, the accessibility to a particular side of the assembly 210 determines which of the subassembly and the window regulator motor holes is threaded since access to the bolt head is required.

SUB A13

[47] With reference to Figure 7 there is shown an assembly 310 including the subassembly 115 of Figure 5 and a window regulator motor 316 having an outer surface 338 and a protuberant part 342 which has an end surface 344 and side surface 345. The distance between the end surface 344 and the outer surface 338 is H_4, which is less than H_A.

SUB A14

[48] Alignment in the Y direction is determined by contact between the outer surface 338 and the inner surface 139, and there is no contact between the heat staked portion surface 129 and the end surface 344. Hence the alignment in the Y direction between the window regulator housing 114 and the window regulator motor 316 is only sensitive to tolerances on the thickness of the door panel 112.

[49] Consideration of Figure 7 shows that, as in the previous embodiment, alignment in the X direction between the window regulator motor 316 and the window regulator housing 114 is provided by co-operation between the internal side wall 130 and the outside surface 121 of the protrusive part 118 and also by co-operation between the inside surface 123 of the protrusive part 118 and the side surface 345 of the protuberant part 342.

SUB A15

[50] It is important to recognise in this embodiment, that as previously described, the feature (in the form of the protrusive part 118) serves to align the door panel 112 (the first component) with the window regulator housing 114 (the second component), the protrusive part then being deformed to secure these components together to provide the subassembly 115. The feature (the protrusive 118) co-operates with the window regulator motor 316 (the third component) to provide alignment between the second and third components.

[51] In this embodiment the subassembly 315 includes a clearance hole 336, and the window regulator motor 316 includes a pilot hole 340. The diameter of hole 336 is greater than that of hole 240.

[52] The subassembly and the window regulator motor are secured using a fourth component in the form of a self tapping screw 319, the self tapping screw passing through hole 336 and screwing into hole 340, so as to releaseably secure the window regulator to the subassembly. Note that hole 340 is utilised to provide a lead-in for the self tapping screw.

[53] Note that in other embodiments the diameter of hole 336 may be smaller than that of hole 340, in which case the self tapping screw passes through hole 336 and screws into hole 340, so as to releaseably secure the window regulator to the subassembly. Note that in this case, hole 336 is utilised to provide a lead-in for the self tapping screw.

[54] As in the embodiments described in Figures 5 and 6, the accessibility of the assembly 310 determines which of the subassembly and the window regulator motor holes is greater since access to the head of the self tapping screw is required.

[55] Note that in further embodiments, the assembly is not restricted to door panels, window regulator motors and window regulator housings, and is equally applicable to assemblies in which at least two components are required to be aligned and/or secured relative to each other.

SUB A16

[56] Furthermore other deformation techniques exist, such as the bombardment of the component by ultrasonic waves, to increase plasticity, followed by a suitable upset tool to achieve the desired final form. Alternatively it is also possible to mechanically deform the component without the need of an external energy source such as ultrasonic waves or heat. This would require a suitably configured upset tool and mechanical deformation process.

[57] In further embodiments the deformed portion and/or alignment feature may be non-circular in cross section, e.g. hexagonal or square, as opposed to the

cylindrical/frustoconical sections described in the embodiments of Figures 1 to 7. The use of non-circular cross sections would prevent rotation between the various components.

[58] In further embodiments there could be two or three or four or more deformed portions and/or two or three or four or more alignment features. The deformed portions and/or alignment features are provided at spaced locations and thus prevent rotation of the various components. Where there are 3 or more deformed portions or alignment features these need not be positioned on a straight line.

[59] Note that door panels 12 and 112 are in a substantially vertical plane, and that with the window regulator motor and the window regulator housing assembled either side of the door panel, both the protuberant parts 42, 142, 242, and 342, and the feature 18,118 extend in a horizontal plane relative to the door panel.

[60] The feature is therefore able to provide resistance to shear loads transferred via the window regulator motor and/or the window regulator housing and the protuberant part is able to provide resistance to shear loads transferred via the door panel. These shear loads act as a result of the motion of the vehicle, as well as due to the weight of the window regulator motor and the window regulator housing with respect to the feature, and the door panel with respect to the protuberant part.

[61] With the assembly in, for example, the front and/or rear doors, shear forces due to the vehicles motion will be due to braking and accelerating, and also due to bump loads as a result of the road surface. With the assembly in, for example, a rear tailgate, shear forces will result from bump loads and also cornering loads.

[62] It will be appreciated that it is the loads which act parallel to the door panel which result in shear forces in the feature/protuberant part. Hence, cornering loads, which act normal to the direction of travel of the vehicle, will not provide any shear force in the feature/protuberant part when the assembly is in the front and rear doors. Similarly, braking and accelerating forces, which act in the same direction as the direction of travel of the vehicle, will not provide any shear force in the feature/protuberant part when the assembly is in the rear tailgate.

[63] As a result of the horizontal extent of the feature and the protuberant part, shear loads will not act solely on the fourth component, for example, a bolt, or a self tapping screw, and hence the fourth component is less likely to fail.

[64] In further embodiments the deformed portions could be integral with the first component or it could be a separate component such as a plastics rivet.

[65] The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specially described. For that reason the following claims should be studied to determine the true scope and content of this invention.